

BUILDING HOMEBREW EQUIPMENT

KARL F. LUTZEN
& MARK STEVENS



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A-186



A Storey Country Wisdom Bulletin

Building Homebrew Equipment

excerpted from*Brew Ware*
Karl F. Lutzen & Mark Stevens

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Introduction

Take one step into a homebrew store, or flip through the pages of any magazine about homebrewing, and it's easy to see that home-brewing can be an expensive hobby. From the counterflow wort chiller to a refrigerated keg system to a complete brewery, a serious homebrewer can spend thousands of dollars on a homebrewery.

Most of the products offered by the many homebrewing equipment manufacturers and suppliers have been produced with the needs and wants of the consumer in mind. Companies in the brewing industry are constantly coming up with products that they hope will make the brewing process easier, yet also allow the homebrewer to make a better beer. Many of the best-selling homebrewing supplies and "accessories" were created by homebrewers like yourself who developed a product that greatly aided them in their quest for "professional"-quality ales and lagers.

Despite the dizzying number of gadgets on the market, there is one thing to take solace in — brewing is a simple science. No matter if you are a beginner using strictly kits or a professional at a 30,000- gallon-a-year microbrewery, beer is still made using the same five basic steps: making wort, boiling, cooling, fermenting, and packaging (carbonating). You can make award-winning beer using a simple starter kit. Yet there is equipment that doesn't come with the beginners' kit that will help you produce a higher-quality beer. Wort chillers, mashing and lauter tuns, and kegging systems are not required equipment for beginners, but most experienced homebrewers cannot produce their product without them.

All of the equipment described here can be purchased at your local brewing supply store or at one of the growing number of national homebrewing supply distributors. But building this equipment yourself offers two attractions: 1) You will save money; and 2) you can make changes to the equipment as is necessary to work in conjunction with your work or storage space, or existing equipment.

The projects here are designed for anyone from beginning to advanced brewers, kit brewers to all-grain masters. Most presuppose brewing experience (i.e., you will have a rough idea about how to use

homemade equipment), and all require a working knowledge of and access to common tools found in a workshop (drills, saws, hardware, etc.). We hope you enjoy making these products and, with their help, succeed in achieving the ultimate goal — excellent beer.

The Rolling Carboy Carrier

The best way to move carboys is with rolling carboy carriers. They can be made at a minimum cost (we were able to make the rolling carboy carrier with only scrap wood from our work shed), they can be assembled quickly, and they provide a much safer and easier way to handle glass carboys. You basically construct a platform with a lip to keep the carboy in place and then put caster wheels on the bottom so that it can be rolled from the brewery area to the fermenter area. This doesn't solve the problem of moving carboys up and down stairs, but if you brew and ferment on the same level, it's a real back-saver.



The best way to move a carboy is with a rolling carboy carrier like this.

MATERIALS FOR A ROLLING CARBOY CARRIER

1 13" × 13" platform of ¾" plywood

4 1"-wide × 12"-long strips of ¾" plywood

4 swivel coasters

16 #10 ¾"-long wood screws

Directions

1. Cut out the platform and strips from a ¾" plywood sheet.
2. Glue and clamp the strips to the platform in the pattern illustrated.

3. Attach the swivel casters with the wood screws 1" in from the edges (be sure to drill pilot holes first).
4. Set the carboy on the platform, fill, attach airlock, and roll into the fermenter closet or corner.

The Carboy Stand

Milk crates provide an easy way to build an inverted carboy stand for the BrewCap system. A carboy stand is a necessity if you want to effectively drain your carboys after sanitizing them, or if you are interested in using the BrewCap (made by BrewCo in Boone, North Carolina). The BrewCap was developed to allow brewers a more effective way to remove the expended yeast and trub that settle at the bottom of the carboy. With your carboy in an inverted position, the BrewCap holds two tubes in place: The short one extends into the neck and removes the expended yeast and trub, and the long one extends to the top of the inverted carboy and is a pressure-relief mechanism. Using a BrewCap, you will no longer need to siphon the wort into a secondary fermenter, and it is a completely closed system.

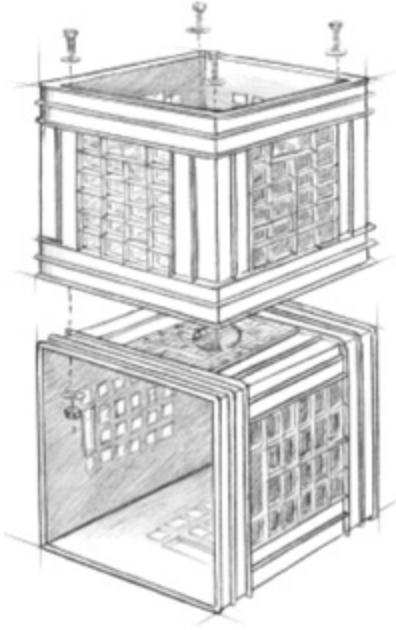
MATERIALS FOR A CARBOY STAND

2 (identical) milk crates

4 bolts, washers, and nuts (size will depend on the size and design of your milk crates)

Directions

1. Saw a hole in the bottom of one of the milk crates (the “top” crate) large enough that the neck of the inverted carboy extends through the hole.
2. Set the second crate (the “bottom” crate) on its side and face the open side toward you; cut a large square hole in the top of the crate to accommodate the neck of the carboy and the hoses.
3. Fasten the two crates together using bolts, washers, and nuts.



Milk crates provide an easy way to build an inverted carboy stand for the BrewCap system.

Immersion Wort Chillers

One of the longest steps of the extract brewer's brewing process (other than the wort boil) can be the cooling of the wort. Especially if you still are using the ice bath and diffusion method of cooling your wort, you know how long it takes to get the 200° wort down to a temperature appropriate for pitching the yeast. The immersion chiller can reduce your cooling time to 15 minutes.

Immersion chillers are usually built from a coil of copper tubing with connectors on each end to which hoses are attached (garden hoses are often used). One connector is run to a source of cold water; the other is run to a drain for expelling the hot water. The immersion chiller offers a simple, effective way to quickly cool hot wort. Cooling wort quickly is important for two reasons. One: You can achieve a more effective cold break, which is the point when suspended proteins drop out of suspension as the wort is cooled. And two: You reduce the amount of time the wort is exposed to possible airborne pathogens.

Basic Immersion Chiller

Chillers are readily available from many homebrewing supply stores for \$30 to \$35; however, they can also be built at home for a bit less than that. One advantage to building the chiller yourself is that you can adapt the plans to suit your own needs. We'll describe a few ways that chillers can be adapted to work more effectively.

When you build a wort chiller, the most critical aspect is the tubing you choose. Copper works well because it efficiently transmits heat energy and is readily available at fairly low cost. Stainless-steel tubing would work, but it costs more. Aluminum also works fine, but some brewers feel that it tends to give the beer a metallic taste. There is, however, no real evidence of such flavor problems. Your tubing should be $\frac{3}{8}$ " in diameter. If you use a thinner tube, you will achieve potentially greater efficiency because the thinner tube will give you more surface area per volume. However, chillers made from $\frac{1}{4}$ "-diameter tubing tend to take much longer to cool wort and are prone to

clogging. Using a $\frac{3}{8}$ "-diameter tubing gives you good efficiency and acceptable cooling times, and it avoids clogging.



You can buy an immersion chiller like this one for about \$30, or you can make one yourself.

MATERIALS FOR IMMERSION WORT CHILLER

25' of $\frac{3}{8}$ "-diameter copper tubing

2 hose clamps

1 inexpensive garden hose (25' is all you need)

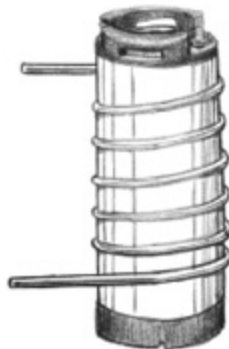
Note: *Lengths of copper tubing greater than 20' usually come in a large coil. Most hardware stores will want to sell you a full box containing 50' to 60' of tubing. Shop with a friend and build two wort chillers if your hardware store will not sell you a cut length (or maybe find a new hardware store!). You could also build two chillers and use the double-coil chiller method that we describe on page 8.*

Note: *Before you begin, you should know that you can easily crimp your copper tubing and ruin that section of it. Once it's crimped, cut out the crimped section and attach a coupler by soldering (lead-free, please). If you don't have a spring tubing bender, buy one when you buy your copper tubing. It will help make the 90-degree bends without crimping the tubing.*

One other point: You should plan to leave enough copper tubing on the ends so that they stick out over the sides of the pot (see illustration on page 7). Once in a while you may get leaks from loose hose clamps; if the tubing–hose connection is outside the pot and it does leak, the water will not drip into the wort.

Directions

1. Turn the copper tubing into a coil. If the copper tubing came in a coil, you can wind it into a tighter coil by hand. This is done by holding one end and turning the coils into ever-smaller coils. You can coil the copper tubing for your immersion chiller by wrapping it carefully around a soda keg if you have a soda keg handy. The final diameter must be small enough that there is at least 2" between the interior sides of the brewpot and the coil. Leave about 18" to 24" on one end.
2. Bend the short end of the tube at the top of the coil 90 degrees out from the coil.
3. Bend the longer end 90 degrees so that the length of the tube goes back up toward the top of the coil.
4. Bend the top part of the long length out from the coil.
5. Cut the garden hose so that each length is at least 5' or 6' long.
6. Slide a clamp over each cut end of the hose.
7. Slip one hose length over one end of the coil. Repeat with the other hose at the other end of the coil.
8. Tighten the clamps to hold the hose lengths firmly to the coil.

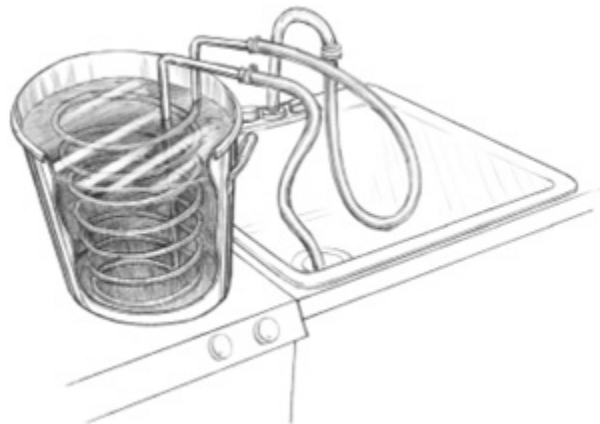


Use a soda keg to bend your tubing.

That's it! Your immersion chiller is ready to use, and it should have cost you less than \$25.

We recommend testing the chiller before brewing a batch of beer, just to convince yourself that everything works and to satisfy yourself that there will be no surprises when the time comes to use the chiller. We tested our chiller by boiling a brewpot full of water, to which we had added ½ gallon of white vinegar, and seeing how long it would take to cool it. The vinegar is important because it will clean the outside of the chiller and prepare it for use in the wort.

In addition to the chiller, you will need a hose that's long enough to run from your faucet to the chiller. If you're using the chiller in your kitchen, as most people do, you may need to twist off the end of your faucet to reveal the threads. These threads should accept a standard hose fitting, but many kitchen faucets need a threaded adapter to accept a hose connection. These are available at most hardware stores for \$1 to \$2. Some homebrew supply shops also sell the adapters. If you can't get the end of your faucet off, or if you just don't want to mess with it, you can buy a rubber adapter that will fit over the end of the faucet, avoiding the need to unscrew the faucet sprayer.

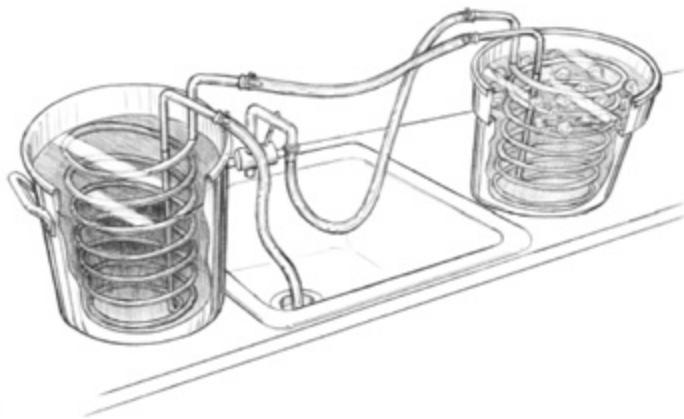


When you are ready to use your immersion chiller, sanitize it by putting it into the boil for 15 to 20 minutes. When the boil is done, attach the hoses — and chill out.

When you're ready to use the chiller, sanitize it by setting it down into your brewpot 15 to 20 minutes before the end of the boil. The heat will destroy any bacteria and other microorganisms on its surfaces. Then when the boil is done, simply attach the hose to your faucet, set the other end of the hose in the sink, and turn on the faucet. Five gallons of wort should cool from boiling to below 80°F in about 15 to 20 minutes. The time will depend on the flow rate and temperature of the water.

Double-Coil Immersion Chiller

If you had no choice but to buy a 50' or 60' length of copper tubing, or if you are worried about wasting water, want faster cooling times, or have a cold-water supply that just isn't cold enough, you can build a chiller with two coils that are connected by a length of hose (see illustration below). Set one coil in a bath of ice water, the other coil in the hot wort, and then run water through the chiller. This is more efficient both because you are cooling the water before it gets to the brewpot and because you are using a single coil with a greater difference in temperature between the cooling fluid and the wort. Thus the heat-exchange process works more efficiently.



Double-coil chiller. This one calls for two coils: the first to lower the temperature of the cold water, the second to chill the wort.

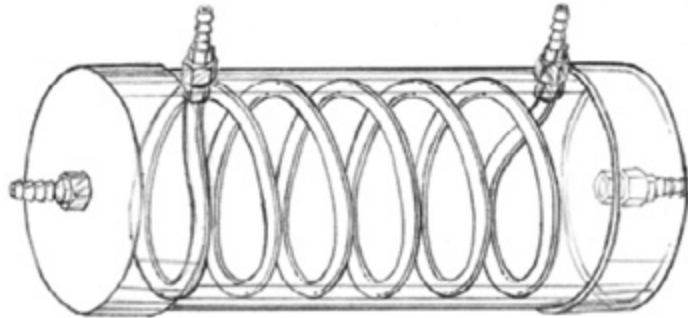
Counterflow Chillers

If you want to run wort through your chiller, instead of running the chiller through your wort, a counterflow chiller is the best way to go. We'll describe several you can build yourself.

PVC Pipe Counterflow Chiller

The PVC pipe counterflow chiller is one of the more popular counterflow chiller designs to emerge over the last several years. It is fairly simple to build and use, and it works faster than most immersion setups. However, as with all counterflow chillers, the inside of the copper tubing needs to be cleaned carefully before and after use because any trace of beer left behind can lead to infection.

The PVC pipe chiller involves taking a 2' length of a large-diameter PVC pipe; inserting a copper coil inside; drilling two holes, one for bringing in cold water and another for expelling hot water; attaching fittings for water hoses; and then sealing the ends. To use: Pump hot wort through the coil while simultaneously pumping cold water through the pipe.



The PVC counterflow chiller (cutaway view) allows cold water to flow through a section of large-diameter plastic pipe, while hot wort circulates through the small-diameter copper coil installed inside the plastic pipe.

MATERIALS FOR A PVC PIPE COUNTERFLOW CHILLER

1 2' length of 6" PVC pipe

2 PVC pipe caps (also called end-caps)

4 $\frac{3}{8}$ " compression \times $\frac{3}{8}$ " MPT adapters

4 $\frac{1}{2}$ " hose barb \times $\frac{3}{8}$ " FPT connectors

10" of $\frac{3}{8}$ " copper tubing

$\frac{1}{2}$ " heat-resistant hose

$\frac{1}{2}$ " PVC hose

25' inexpensive garden hose,

$\frac{1}{2}$ " diameter

PVC cement

Epoxy cement

Teflon tape

Directions

1. Drill a $\frac{1}{2}$ "-diameter hole in each end-cap.
2. Insert the compression end of a $\frac{3}{8}$ " compression \times $\frac{3}{8}$ " MPT adapter into each end-cap and seal with epoxy.
3. Drill a $\frac{1}{2}$ "-diameter hole 2" from both ends of the PVC pipe.
4. Coil the copper tubing and insert it into the PVC pipe.
5. Place a compression nut and ferrule on each end of the coil.
6. Insert the compression end of a $\frac{3}{8}$ " compression \times $\frac{3}{8}$ " MPT adapter into each hole in the PVC pipe.
7. Thread the compression nuts onto the adapters and tighten. Seal the adapters with epoxy cement.
8. Coat the inside rim of an end-cap and the outside of one end of the PVC pipe with PVC cement. Place end-cap on pipe and repeat for other end. Be sure all sealing surfaces are evenly coated with the PVC cement to avoid leaks.

9. Wrap a couple of turns of Teflon tape around each $\frac{3}{8}$ " MPT, thread on the hose barbs, and lightly tighten. Do not overtighten.
10. Add the hoses and you're done! The key to success, however, is making sure you sanitize the inside of the copper tubing.

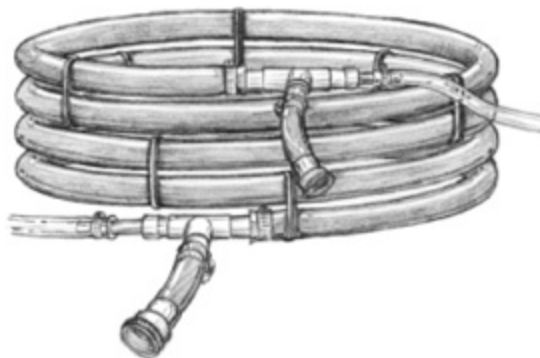
You may want to build a small stand for the chiller using strips of wood. Otherwise the pipe has a tendency to move around. You can either cut a rounded curve in two end pieces, or you can build a four-sided rack — whatever works for you.

Another method for “controlling” your chiller is to wrap a length of 16-gauge wire around the pipe just below one end-cap and twist the ends into a double wire. Bend the end lengths 90 degrees up past the end-cap, make a hook, and hang it from the brewpot handle. Remember: the simpler, the better.

Hose Counterflow Chiller

In the hose counterflow chiller, a copper tube is inserted inside a standard garden hose and the wort is pumped, or siphoned, so that it runs in a direction opposite to the water flow.

Before we delve into a description of making a chiller from scratch, we need to mention that the tube fittings can be bought already made. These fittings are produced by Listermann Manufacturing and are sold under the name Phil's Phittings. This fitting kit sells for about \$15 and really makes building a chiller easy work.



A hose counterflow chiller coiled up and ready for action

MATERIALS FOR A HOSE COUNTERFLOW CHILLER

50' of $\frac{5}{8}$ " I.O. (inside diameter) garden hose

50' of $\frac{3}{8}$ " O.D. (outside diameter) soft copper tubing

6 $1\frac{1}{2}$ "-long pieces of $\frac{1}{2}$ " copper pipe

2 $\frac{1}{2}$ " copper tees

2 $\frac{1}{2}$ " copper end-caps

6 hose clamps

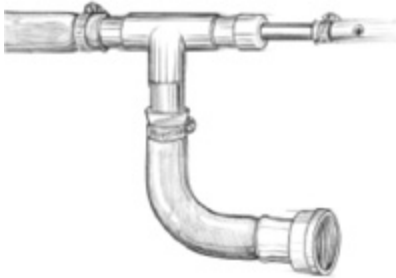
Plastic zip ties or wire

Directions

1. Cut off 8" from each end of the hose and save for Step 9.
2. Insert a $\frac{1}{2}$ "-long copper pipe into each end of the copper tees and solder them in place.
3. Drill a $\frac{3}{8}$ "-diameter hole in the end of each copper end-cap. (*Hint: Start with a $\frac{1}{8}$ " drill and work up to a $\frac{3}{8}$ " drill.*)
4. Place an end-cap on one end of the long leg of the tees and solder into place.
5. Uncoil the copper tubing and feed it through the garden hose.
6. Place a hose clamp on both ends of the hose.
7. Feed the end of the copper tubing through the tee assembly and onto the hose, then tighten clamp. Repeat for other end.
8. Solder the $\frac{3}{8}$ " tubing to the end-caps to seal.
9. Attach the hose ends to the short legs of the tees with hose clamps.
10. Wind the hose and tubing assembly into a coil around a large cylinder, such as your brewpot.
11. Secure the coils together with wire or zip ties.

12. To sanitize the chiller before using it for the first time, run a very hot solution of 75 percent water and 25 percent vinegar through the copper tubing.

Plumbing Setup



In a hose counterflow chiller, a copper tube is inserted in a garden hose. Water flows through the hose (and over the tube) in one direction, while hot wort is pumped through the tube in the opposite direction.

Mash Tuns

Making a mash tun means you are now going to make all-grain beers. Making all-grain beers does take more time, but we think it is well worth the control you gain when you produce your own malt sugars (instead of purchasing them in the form of liquid or powder extract). Three different mash tuns are presented here, and all three can be adapted for lautering and sparging as well.

The most important consideration when designing and building a mash and lauter tun is the ability of the vessel to hold hot (up to 180°F) liquid. A mash tun must be large enough and sturdy enough to hold at least 6 gallons of liquid. It should also be insulated; if it is not insulated, it should be made of an appropriate material that will allow you to apply direct heat to maintain the right mash temperature. The mash tuns described here can also be used as lauter tuns with the addition of a sparge water sprayer and a false bottom. See page 16 for false bottom tips, see page 19 for sprayer tips.

Mashing in a Picnic Cooler

Large, chest-style picnic coolers make ideal mash tuns because they are well insulated and inexpensive. For a 5-gallon setup, look for a 34-quart cooler (about \$10 to \$15). The next size up is usually the 48-quart cooler, which will handle 10- or 15-gallon batches without a problem. Although 48-quart coolers are larger than you'd really want when doing 5-gallon batches (they may give you a shallow grain bed), quite a few homebrewers use that size without a problem. For very large batches, 60- or 80-quart coolers are reasonable. One consideration when choosing a cooler is its resistance to heat. If you can find a brand that claims to withstand 170°F temperatures, you're ahead of the game. If not, you're still okay. Most of them don't warp too badly, and even if they do, they'll still hold heat well enough to mash — and besides, they're cheap. Building a new one every year or so is no big deal.

Once you have the cooler, you may need to drill out a drainage plug if it doesn't already have one. Because we're using ½" diameter CPVC

pipe for this project, drill a $\frac{5}{8}$ "-diameter hole (the outer diameter of a $\frac{1}{2}$ "-diameter CPVC pipe). Although the drainage hole in a cooler is usually on the side, having the hole in the bottom is actually a bit more workable in many situations. Next, you'll have to build a drainage manifold to lay in the bottom of the cooler.

MATERIALS FOR MASH-TUN CONSTRUCTION

6' of $\frac{1}{2}$ "-diameter CPVC pipe

4 90-degree elbows for $\frac{1}{2}$ "-diameter CPVC pipe

5 tee connectors for $\frac{1}{2}$ "-diameter CPVC pipe

Food-grade silicone or epoxy sealant

$\frac{1}{2}$ "-diameter I.D. (inside diameter) poly tube

Picnic cooler

Tools

Hacksaw

$\frac{5}{8}$ "-diameter drill bit and drill (if the cooler does not have a drain)

Directions

1. Measure the length of the cooler bed. Subtract 4" and cut four lengths of CPVC tubing to that length.
2. Measure the width. Subtract 4" and divide by three. Cut six lengths of CPVC tubing to that length. Cut one of these lengths in half. Now use a hacksaw and cut thin slots in all the pipes, about one-third of the way through. Assemble the manifold as shown in the illustration on page 13.
3. You can glue the manifold together, but it will be easier to clean if you make it easy to disassemble. One idea that works well is to permanently glue the two end units together, and then just piece together the four long rods when it's time to brew.

One other idea that seems to work well is to replace the CPVC with copper pipe, which is readily available at most plumbing supply stores and is fairly inexpensive and easy to work with.

You could add a valve to the manifold outlet if you wish, but a simple and less expensive approach is to use a length of vinyl hose a hose clamp, and a pinch-cock-type (siphon) clamp. Push a length of hose over the outlet tube and secure it with the hose clamp. Feed the hose through the siphon clamp. This will be your valve. By closing and opening this clamp, you can adjust the flow of your runoff. If you wish to use a valve, CPVC ball valves are available for about \$3 to \$5. Compression fittings with gaskets are also available for CPVC tubes, and if your cooler does not already have a drain plug in the wall, consider using one of these. Before drilling through the wall, remember that you could also go through the bottom rather than the side.

Mashing in a Water Cooler

The large, cylindrical water coolers that you often see on the back of construction trucks or on the sidelines of pro football games make ideal mashing vessels. They are available in sizes that are large enough for home mashing, and they are well insulated. The brand most often used by homebrewers is the Gott cooler, which is made by Rubbermaid.

This cooler is known to withstand the heat of a mash without warping, as often happens with cheaper coolers. The 10-gallon size is the one you'll want; it usually runs about \$50 at outdoor or construction supply stores, although it can be found at discount warehouses for as little as \$30.

An easy way to use the cooler is to put a vegetable steamer in the bottom of the cooler and then set the grains on that. We've found this works acceptably well, but it does tend to let a lot of grains through. Another idea is to get a colander that's smaller than the circumference of the cooler and set it upside down in the bottom of the cooler. You may want to rig some kind of drainage device, such as the JSP EasyMasher (available from Jack Schmidling Productions), to go inside the colander. Phil's Phalse Bottom (available from Listermann

Manufacturing) is an excellent choice for use as a drainage system with the Gott coolers, and this is the method that we recommend. The Phil's Phalse Bottom is simply a heavy plastic cone with perforations. It's available at many homebrew supply shops.



Round water coolers make great mash tuns. You can use a vegetable steamer as a false bottom or, better yet, a colander.

You can also build a manifold, much like that described in the picnic cooler mash tun directions.

With the Gott cooler masher, you will need to install a valve of some kind. The push-button spigot is inadequate (unless you want to hold in the button for the hour or so that a sparge might take).

Modified Keg with False Bottom

Modified kegs, if not the most commonly used mash tun, are probably the most talked about and respected. Kegs are sturdy and inexpensive, and they work well. You can apply heat directly to them, and you can modify them with false bottoms and valves to make sparging simple. They are also easy to clean.

The first thing you will need is a legally obtained keg. Do not think that paying the deposit for a full half-barrel, consuming the contents, and then keeping the keg is a legal means of acquiring one. It is not. Instead, you will need to talk to the distributors in your area. Sometimes they are willing to help, and sometimes they'll barely give you the time of day. Other sources are salvage yards and scrap-metal

dealers. Before you begin to modify your own keg, you will need an assortment of gear.

***Note:** You are working with stainless steel, which is tough stuff. The basic rule when working with it is, the slower, the better.*



A modified keg with false bottom makes a long-lasting mash tun.

MATERIALS FOR MODIFYING A KEG

$\frac{3}{8}$ " copper tubing

8" -diameter perforated stainless steel for false bottom

1 $\frac{3}{8}$ " compression nut and ferrule

2 $\frac{3}{8}$ " male pipe thread (MPT) \times $\frac{3}{8}$ " compression adapters

1 $\frac{1}{2}$ " I.D. (inside diameter) stainless-steel washer

2 $\frac{1}{2}$ " I.D. (inside diameter) nylon washers

1 $\frac{3}{8}$ " ball valve with $\frac{3}{8}$ " female pipe thread (FPT)

12" square perforated stainless steel

Permanent marking pen

Lightweight oil

Teflon tape

Tools

Hearing and eye protection. You are about to embark on the noisiest job you've ever started.

Variable-speed saber saw or reciprocating saw. A two-speed unit is not good enough; the slowest setting is still too fast.

Five bimetal saw blades (32 teeth per inch or better). You may need more. A small angle grinder would work fabulously for cutting a keg.

Center punch (or nail and hammer)

$\frac{3}{8}$ " electric drill, variable speed preferred

Assortment of drill bits

Grinding wheel

Directions

1. Without a blade in the saw, set the saber saw against the inside top of the keg. You are finding out how close you can cut to the handles, as the saw body will be the limiting factor.
2. Mark a point where the blade will be cutting. Draw a circle around the top inside of this mark. In our case, we were able to make an opening 12" in diameter in our keg.
3. With a center punch (or nail and hammer), mark a point $\frac{1}{8}$ " from the line inside this circle.
4. Drill a $\frac{1}{4}$ " hole at that point. (It is easier if you drill a smaller hole first and then enlarge it.)
5. Install a blade in the saw, oil it, and at a slow speed carefully cut out the top of the keg. Plan on spending at least 45 minutes on this phase.

6. With the grinding wheel in the drill, grind off all sharp edges.
7. Mark a point $\frac{3}{8}$ " above the bottom weld line.
8. Drill a $\frac{1}{2}$ "-diameter hole. (Again, start small, then enlarge the hole.)
***Note:** You are done cutting and about to start assembling your mashing vessel. This is a good time to scrub the interior of the keg. It will save time later. Also, clean all parts before final assembly. That, too, will help.*
9. Place the stainless-steel washer and then a nylon washer on the pipe-thread end (the large end) of a $\frac{3}{8}$ " MPT \times $\frac{3}{8}$ " compression adapter.
10. Insert this into the $\frac{1}{2}$ "-diameter hole. It will fit tightly, and you will have to use a wrench to finish the job. You may have to enlarge the hole slightly beyond $\frac{1}{2}$ ".
11. Place the other nylon washer over the pipe threads.
12. Wrap Teflon tape around the threads.
13. Thread on a $\frac{3}{8}$ " ball valve and tighten. Be sure to use a wrench on the inside to hold the adapter in place.
14. Drill a $\frac{3}{8}$ "-diameter hole in the center of the perforated metal (false bottom).
15. Bend the end of the $\frac{3}{8}$ "-diameter copper tubing to 90 degrees. This bent end goes through the false bottom.
16. Set the false bottom and tube assembly in the bottom of the keg.
17. Measure and cut the copper tubing so that it fits into the inside $\frac{3}{8}$ " compression fitting.
18. Attach the tubing to the $\frac{3}{8}$ " compression fitting with a compression nut and ferrule.
19. Add a $\frac{3}{8}$ " MPT \times $\frac{3}{8}$ " compression fitting to the ball valve output. By using a $\frac{3}{8}$ " compression nut, you can either connect this to your

counterflow chiller or add a small piece of $\frac{3}{8}$ " copper tubing for a spigot and attach a vinyl hose.

Note: Instead of using the adapters, washers, and all, you could just take the keg and have two $\frac{3}{8}$ " female nipples welded to the hole. A welded nipple will also be easier to clean and sanitize. You would need a $\frac{3}{8}$ " male nipple to attach the ball valve and a $\frac{3}{8}$ " MPT to $\frac{3}{8}$ " compression adapter to attach the copper tube. Wrap the male threads with Teflon tape before installing.

Before you start brewing for the first time, fill the keg with 12 gallons of water and add 1 gallon of white vinegar. Bring the mixture to a full boil and boil it for about 15 minutes. Drain. Now everything should be ready for your first batch in your new mash tun.

Sparging Tips

To introduce sparge water to the grain bed in your picnic cooler, water cooler, or modified keg mash tun, you can construct a simple sparge sprayer out of CPVC pipe. Simply obtain two lengths of thin CPVC supply line ($\frac{3}{8}$ " will be fine) and cut one to the length of your cooler or to the diameter of your modified keg (the other length will be slighter longer than the width of your cooler or the diameter of your keg). Next, cap one end of this pipe and drill very small holes in the pipe (see illustration below).

To do this, we acquired a couple of $\frac{1}{32}$ " drill bits from a hobby shop (they break easily!) and drilled holes about $\frac{1}{2}$ " apart on one side only along the entire length of the pipe. Glue the second length of CPVC, which is cut a bit longer than the cooler's width or keg's diameter, to the long tube and at a right angle to it. The second pipe simply supports the sprayer and provides stability when it's positioned over the top of the cooler.

Now push the vinyl tube over the end of the CPVC tube. Depending on the size of your hose, you may have to add a hose barb adapter to hook the CPVC to the vinyl hose. If you use $\frac{1}{2}$ "-

diameter CPVC pipe, a $\frac{5}{8}$ "-diameter I.D. (inside diameter) poly hose will fit tightly over the end. Then siphon the sparge water into the sprayer.



This is a bottom view of the sprayer: The holes need to point down to spray onto the grain bed.

Kegging

If there's one gadget that marks the transition from the casual home-brewer to the die-hard hobbyist, it's the keg system. Bottles are fine when you're starting out and not sure how dedicated you are to the hobby; but once you're hooked, the advantages of kegs over bottles are just too obvious to be ignored.

When you bottle, you've got 50-some bottles to wash and sanitize for every batch, and it takes a lot of time to fill and cap each one. Whereas beginning homebrewers worry about the cost of kegging setups, experienced homebrewers willingly spend the money. It's a trade-off between time and money.

Making a Keg System

There are, of course, benefits to bottles too. They're easy to carry and hand out to friends. They're easy to store for long periods of time. They're easy to send to competitions. As we've said, it's a trade-off. You can still fill bottles with a keg system setup, and we've included the counter-pressure bottle filler project just for you.

The kegs used by homebrewers are usually used soda kegs. These are available at many homebrew supply shops. Many homebrewers get their kegs by buying excess kegs from local soda-bottling companies, from restaurants, or from junk dealers. When you buy from these sources, you'll need to refurbish the keg (turn to page 23 for those instructions). Homebrewers often refer to these kegs as Cornelius kegs, after one of the companies that makes them. Yours may or may not be a Cornelius keg; it could be a Firestone or John Wood.

If you've ever thought about getting into kegging and want to use refurbished soda kegs, now may be your last chance. Soda companies are increasingly abandoning kegs for plastic bags. Now easy to come by cheaply, the supply of kegs will dry up once the soda companies switch.



A complete kegging setup includes: a stainless-steel keg, a CO² tank, a regulator with pressure gauge, and various taps, hoses, and connectors.

There are two important things to know about any keg you're buying: size and lock type. Most homebrewers use 5-gallon kegs, the most commonly available size. You can also find 3-gallon and 10-gallon kegs. Foxx Equipment sells new kegs in both 3-gallon and 5-gallon sizes. The locks can be either the pin type or the ball type. You can tell which is which by looking at the hose connectors (fittings) on your keg. If there are two knobs (pins) sticking out from the base of one fitting and three knobs sticking out from the base of the other, it's a pin lock. You slide steel hose connectors over these pins and then twist to lock the hoses onto the keg. Ball-lock valves, which are smooth all the way around, use a locking ring to attach the hoses. Whichever type of lock you prefer, get several kegs, and make sure they all have the same type of lock (or get two CO² supply lines).

The CO² tanks are large steel cylinders containing pressurized carbon dioxide. They are available in different sizes — the smallest used by homebrewers is referred to as a 5-pound tank, the largest, a 20-pound tank. A 10-pound tank is also available. The 20-pound tank is preferred by many of the more serious homebrewers because it means fewer trips to a gas supplier to get it filled. At the top of the CO² tank is a valve handle for turning the flow on and off. The regulator and gauges attach to a threaded nut on the side of the tank.

The regulator reduces the high pressure of gas coming out of the cylinder to the pressure you want going into your keg. This is accomplished simply by turning a screw on the regulator. Attached to the regulator is a gauge that shows the pressure of gas leaving the

regulator. If you've got a second gauge, it shows the pressure of gas coming into the regulator (the pressure of the CO² tank). Many regulators also come with a check valve, or there is one attached to the gas-out line.

MATERIALS FOR A KEG SYSTEM

Stainless-steel keg

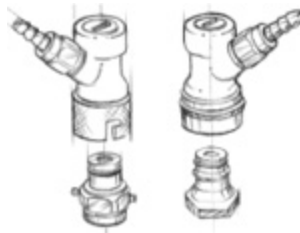
CO₂ tank

Regulator with pressure gauge

Connectors

Tap

Hoses



Typical pin and ball locks commonly found on kegs used by home-brewers. A pin lock has knobs or pins that fit into each other. A ball lock has a locking ring.

You'll also need a keg connector on each valve: one for the gas line to the CO² tank, the other to your tap. The two connectors are different, and you'll need one of each. Further, the connectors are not interchangeable, making it impossible (well, in theory it's supposed to be impossible) to connect a line to the wrong valve (assuming you put the right connector on the right line). You may also need a barbed connector to attach to your regulator.

Most homebrewers use a plastic tap faucet attached to a length of plastic hose as their tap. The plastic taps, which are inexpensive and can be taken apart for easy cleaning, are often listed in supply catalogs as "picnic faucets." If you happen to get your hands on an extra

refrigerator, you can modify the fridge and put a tap in the door (see directions on page 25).

Portable Tanks and CO² Sources

Very small portable CO² tanks, which you can fill from your larger supply tank, are also available to homebrewers who want to take a keg to a party without bringing along a big pressure tank. You can find portable tanks in sizes as small as 3½ ounces. West Creek Home Brewing also has some nifty gadgets for handling CO², such as a cap for charging a PET (polyethylene terephthalate) bottle to 30 psi as a portable CO² source.

Another source of tanks and gas is your local compressed-gas dealer. This could be a welding shop or a business dealing exclusively with compressed gas. Check your phone book for more information. These places sometimes offer what is called a “lifetime lease” on a tank. Effectively you buy a tank and every time you need a refill you bring in the tank, pay the refill charge (for a 20-pound tank, it’s usually less than \$20), leave the empty tank, and walk out with another filled and certified tank. You never have to worry about a bad tank — a rare event in any case. The vendor takes the empties and recertifies them (if necessary), then fills and “sells” them to someone else. A lifetime lease may cost about \$75.

***Note:** Tanks are required to have certificates showing that they have been pressure-tested. This is done (if needed) when you fill the tank. If a tank fails a pressure test, the certifier will drill a hole in it, preventing it from being used again.*

Refurbishing Used Kegs

Okay, you’ve managed to obtain some old kegs from a soda bottler . . . what next? Now you’ve got to clean out those kegs and replace the rubber seals.

Most homebrew supply stores either have these parts or can get them. Foxx Equipment also sells all the gaskets as well as replacement poppets (spring valves inside a fitting) and other parts. Gaskets cost

anywhere from about 25 cents to about a dollar each, and \$5 will get you a complete set. Poppets are cheap too, usually less than \$2 apiece.

MATERIALS FOR REFURBISHING A USED KEG

Rubber gasket for the lid

Rubber O-rings for the two valve fittings

Rubber O-ring for the gas dip tube

Rubber O-ring for the liquid dip tube

Directions

1. Release any pressure left in the keg. Use the pressure relief valve if the keg's got one; otherwise, press down with a screwdriver on the gas-in line.
2. Remove the lid by lifting up on the bail (the release handle).
3. Use a wrench to remove the two valve fittings. There will be tubes attached to the fittings inside the keg. Pull these out, too.
4. Examine the poppets. If they are damaged or worn, replace them.
5. Clean the keg with TSP, B-Brite, iodophor, or similar cleaner, as described on the next page.
6. If the liquid (long) and gas (short) tubes are plastic, consider replacing them.
7. Replace O-ring gaskets on the liquid tube and gas dip tube.
8. Replace O-rings on the outside of the valve fittings.
9. Reassemble the tubes and fittings, screwing them back onto the keg.
10. Replace the gasket on the lid.

Cleaning Soda Kegs

Although homebrewers often praise stainless steel because it is easily sanitized, keep in mind that older beer kegs (and some kegs from

Europe) are aluminum, and some of the cleaning agents used for stainless steel can damage aluminum.

The best sanitizing solutions to use with kegs are iodophor and trisodium phosphate (TSP). Use a plastic scrubber to loosen deposits or settled matter on the insides of kegs. TSP can be left to soak in the keg; if you get a used keg, soaking it overnight or for a couple of days will not hurt the surface. You can also store your unused kegs with a TSP solution in them.

Sometimes a layer of beer matter can settle and harden onto the bottom of a keg; this is referred to as “beer stone.” If beer stone begins to build up in your keg, you can remove it with an acid solution. Let the keg soak for 2 to 6 hours. Use food-grade phosphoric acid in a solution at a strength of 1.7 to 2.0 pH and a temperature of 120° to 130°F. Then scrub the stone with a plastic abrasive. The acid dairy rinse is perfect for removing beer stone. Beverage line cleaner may also be useful.

When you’re cleaning kegs, keep in mind that household bleach should never be used. Bleach is an effective sanitizer for glass and plastic surfaces, but it will corrode stainless steel. Stick to iodophor or TSP.

Modifying Refrigerators for Kegs

The first order of business for accommodating kegs to fit your refrigerator is to remove the shelves. A soda keg sits about 2½’ high, a 5-pound CO² tank about 1½’ high. You’ll probably want these to sit upright, so removing the shelves is a necessity. You may also want to look at the bottom shelf to see how it’s supported. Often the bottom shelves are made of glass and are supported on the sides by molded plastic, and sometimes in the middle by a brace. You may want to remove this shelf and replace it with something a bit sturdier, such as a piece of ½” plywood braced under the middle and sides by 2” by 4” braces. A keg weighs about 50 pounds when full, so the shelf and supports need to be pretty strong.

Most homebrewers like adding tap handles to the outside of the fridge so they don’t have to open the door every time they want a beer.

This is a fairly straightforward modification. The tap handles and shanks that go through the door are available from Foxx Equipment and most likely your local homebrew store. The size you get will depend on the thickness of your refrigerator door (or side wall). If you're drilling through the side wall, be aware that some refrigerators have gas lines running in the walls. If you puncture one of these, the refrigerator will be useless. If the side of the refrigerator is warm to the touch, it probably contains gas lines.

MATERIALS FOR MODIFYING A REFRIGERATOR

Beer shank

Wall flange

Flanged jam nut

Tail piece and hex nut

Beer faucet

Tap handle

Drip tray

Direction

1. Measure the thickness of the refrigerator wall before ordering your shank. You'll probably want about a 4" or 5" shank, but the length depends on the thickness of the refrigerator wall.
2. Drill a hole through the refrigerator wall to accommodate the shank.
3. Put the wall flange on the shank.
4. Insert the shank through the door.
5. Apply a small amount of caulk around the area where the shank passes through the door, inside and out, and secure with the flanged jam nut on the inside.



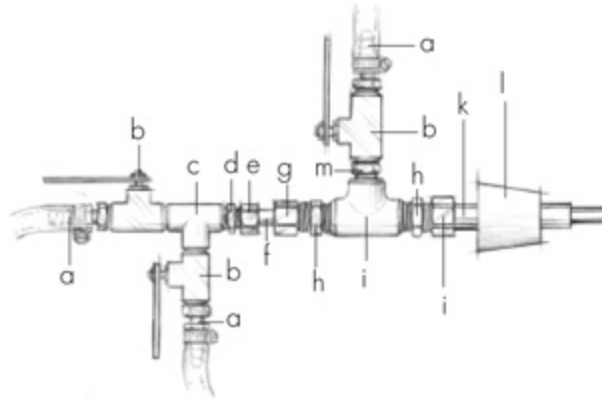
If you store beer in a keg in a refrigerator, install a tap on the door or side wall. You won't have to open the door each time you want a beer, and it looks professional.

6. Attach the tail fitting with the hex nut onto the shank on the inside.
7. Screw the faucet onto the outside of the refrigerator.
8. Screw the knob onto the faucet.
9. Screw the drip tray onto the refrigerator about 1' or so below the faucet (allow enough space to accommodate your largest beer glass).
10. Attach your beer line to the barbed tail fitting, then tighten the hose clamp.
11. Connect to your keg and enjoy.

Counter-Pressure Bottle Filler

With your keg system in full operation, you probably find that you have a lot of extra time on your hands with no more bottles to fill. We suggest you use that free time to build a counter-pressure bottle filler. The counter-pressure bottle filler lets you store and carbonate your beer in a Cornelius keg and then apply CO² pressure to fill a bottle, purging air and nearly eliminating the chance of oxidized aromas and

flavors. It also fills bottles gently and retains the carbonation in the beer.



A counter-pressure filler assembly lets you store beer in a keg, then use CO² pressure to fill bottles. Note the No. 2 stopper, which you place in the opening of your clean and empty beer bottles.

MATERIALS FOR A COUNTER-PRESSURE BOTTLE FILLER

3 1/4" MPT × 1/4" hose barbs

1 1/4" FPT tee

1 3/8" FPT tee

1 1/4" MPT × 1/4" compression fitting

2 3/8" MPT × 3/8" compression adapters

3 1/4" MPT × 1/4" FPT on-off valves

1 1/4" compression nut and ferrule

2 3/8" compression nuts and ferrule (only one ferrule needed)

1 3/8" O.D. (outside diameter) O-ring

1 3/8" MPT × 1/4" FPT adapter

1 No. 2 drilled rubber stopper

1 5/16" hose tee for gas line

1 18"-long, 1/4"-diameter tube (stainless steel, brass, or copper)

1 2"-long piece of 3/8"-diameter tube

Teflon tape

Parts List

a – 1/2" MPT × 1/2" hose barb

b – 1/2" MPT × 1/2" FPT on-off valves

c – 1/2" FPT tee

d – 1/2" MPT × 1/2" comp adapter

e – 1/2" compression nut and ferrule (not shown)

f – 18" long 1/2" copper or stainless tubing

g – 3/8" compression nut with 3/8" O.D. (outside diameter) O-ring (instead of ferrule)

h – 3/8" comp × 3/8" MPT adapter

i – 3/8" FPT tee

j – 3/8" compression nut with ferrule (not shown)

k – 3/8" copper or stainless tubing, 2" long

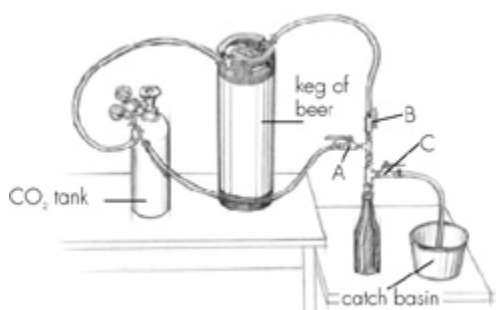
l – #2 stopper with 3/8" hole

m – 3/8" MPT × 1/2" FPT adapter

Direction

1. Wrap the male connectors with Teflon tape.
2. Assemble according to the diagram on page 26. You'll want the tee for hooking up the CO² gas line as shown in the illustration.

To use the counter-pressure bottle filler, first sanitize it with iodophor. Do not use chlorine bleach. Connect everything as shown in the illustration. Insert the filler into a clean bottle. Make sure the stopper seals well, then turn on the gas valve (valve A) to pressurize. Turn off the gas valve A. Turn on the beer valve (valve B). Open the bleed valve (valve C). As the gas escapes from the bleed valve, the beer in the keg will be at greater pressure than that of the bottle and will slowly fill it. When it gets full, close the beer valve (valve B). Remove the filler, then close the bleed valve (valve C) and cap the bottle. If you close the bleed valve too soon, there will be pressure in the bottle and there will be a spray of foam when you remove the filler.



To use a counter-pressure bottle filler, turn on gas valve (A) to pressurize. Then turn off gas valve, and turn on beer valve (B) and open the bleed valve (C). Gas will escape from the bleed valve and the beer in the keg will be at greater pressure than that of the bottle and will slowly fill it.

Transferring Liquid under Pressure

Once you have a keging system with a CO₂ tank and regulator, you can use pressurized carbon dioxide to move liquids from one vessel to another without having to rely on siphons and gravity. For example, you can force-rack beer from one carboy to another under CO₂ pressure, avoiding the worries of starting the siphon and reducing oxidation risk by purging vessels with a blanket of CO₂ gas. Transfers can thus take place in a “closed” environment, which means that the vessels are never open to airborne contamination risks.

1. Seal up the container holding the liquid.
2. Attach a tube from the liquid to the empty vessel.
3. Attach a gas-in line to the carboy cap, keg, or whatever.

4. Slowly open the gas line.



If you have a kegging setup, there is no need to siphon beer from your carboy. Use your CO² cylinder and a racking configuration like this.

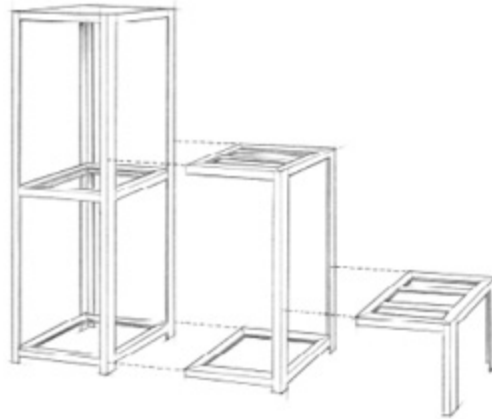
Brewery Design

If you have committed to all-grain brewing and use modified kegs (see pages 16–18) as your brewing vessels, you will want to arrange your vessels in such a way as to take advantage of process flow and gravity. A tower design, the most common, is time-tested and has been used for hundreds of years, if not thousands. It starts with grain on the highest level of the brewery, where it's milled and sent down a chute into the mash tun. From there, the mash is lautered (run off and sparged) and the liquid is piped down a level to the brew kettle. After the boil, the hot wort is chilled and sent down another level to the fermenter.

Building a Tower Brewery Stand

The stand is best set up in a permanent location. Using modified kegs as brew vessels, the overall dimension are 7' high by 4½' wide by 1½' deep. Construct it from 1" angle iron, or use uni-struts (steel angles with predrilled holes) if you do not have access to a welder. The top level should be 5' high, the second level 36" high, and the bottom level about 12" off the ground. The width and length of each level of platform will depend on the size of your brewing equipment. Generally, for modified kegs, about 18" square will work for the shelves. Widen the middle level for the longer dimensions of a picnic-cooler mash tun.

Make sure you have a small stepstool for filling the top pot, as you do not want to lift a full pot to that height. This is a good application for a pump. If you wish, a single, large propane tank can be strapped onto the outside of the frame instead of messing about with two or three bottles. Indeed, there may be a substantial savings on propane costs in doing this. Many places charge a flat rate to fill a 20-pound bottle, regardless of how much is left in the tank. If you brew many batches, it may be a better idea to connect to a large outdoor propane tank and really save some money.



You can build a three-level stand out of metal for a classic gravity-flow tower system. Modify this basic design to fit your own needs.

MATERIALS FOR A TOWER STAND

Legs

4 60" × 1" lengths of angle iron

2 36" × 1" lengths of angle iron

3 12" × 1" lengths of angle iron

Shelf supports

24 18" × 1" lengths of angle iron with ends cut to 45 degrees

Cooker shelf cross member

6 17 ¾" × 1" lengths of angle iron

Shelves for propane bottles

3 18" square sections of expanded aluminum or steel

Heat shields

2 18" × 24" long thin aluminum sheets

3 low-profile 125,000 BTU cookers with bolting brackets on bottom (Camp Chef — Low Profile)

Direction

1. Cut out all materials as indicated above.

2. Assemble four shelf supports into a square.
3. Select three shelf frames for the top cooker shelves.
4. Measure the distance between the bolt holes on the cookers. Add 1 to this number and subtract from 18. Divide by 2. Measure in this distance from the ends, and set two cross members at this point and weld. Do the same for the other two shelves.
5. Set the cookers in the center of one of the shelves, mark the mounting holes onto the frame, and drill holes into the cross members. Do the same for the other two shelves. (Do not mount the cookers yet.)
6. Clamp the 60" legs onto one of the cooker shelves and weld.
7. Clamp a propane bottle shelf 1" from the bottom of the 60" legs and weld.
8. Clamp and weld a second propane shelf 28" from the top of the bottom shelf.
9. Clamp and weld the two 36" legs onto another cooker shelf.
10. Clamp the last propane shelf 1" from the bottom of the 36" legs and weld.
11. Weld the middle shelf assembly to the first shelf assembly.
12. Clamp the two 12" legs onto the last cooker shelf and weld into place.
13. Weld this short shelf assembly onto the main shelf assembly.
14. Bolt one propane cooker onto each of the cooker shelves (top shelves).
15. Using either screws or pop rivets, attach a heat shield to the legs next to the center cooker; then do the same for the bottom cooker. These prevent the bottles of propane from getting too hot.
16. Put the expanded metal sections on the propane-bottle shelf frames. These sections do not need to be anchored to the frames, but you can do so if you wish.
17. Set the assembly in its permanent home.
18. Add propane bottles, and connect them to the cookers. *Check for gas leaks at all connections!* (A mixture of dish soap and water applied to each

connection will bubble if there is a gas leak.) Leaks can be sealed with Teflon tape.

19. Add kettles and you are ready to brew.



The completed stand for a gravity-flow tower system: As you can see, it is best set up in an extremely well-ventilated location.

Note:*If you take this to a professional welder and he makes some recommendations that are different from those stated here, please listen to him. He may suggest improvements that could strengthen the system.*

Many homebrewers use other types of mashing vessels, such as picnic coolers with manifolds. These, too, are easily adapted to the gravity-flow tower model. Simply put a burner and a pot for heating water on the top level. Put the cooler mash tun, complete with sparge apparatus, on the second level; then run a tube from the hot-water pot to the sparge apparatus. Finally, drain the mash tun directly into a brew kettle on the lower level.

To build such a stand, assemble the large- and small-shelf stands as described in the gravity-flow tower system. The center shelf will need to be 28" wide for a 48-quart cooler, or 36" wide for an 80-quart cooler. As you will not be adding the low-profile cooker to this shelf, the stand will also need to be 6 to 8" taller, depending on the style of

cooker used. Weld this center stand to the tall and short stands. Be sure to use a heat shield next to the burner to prevent melting the cooler.

Afterword

We hope the projects here have inspired you to take your next step toward becoming a better brewer, whether that means going to a keg system or simply building an immersion chiller. Do keep in mind that these projects and designs were based on our experiences and fit our needs as brewers at the time. Feel free to modify them and use materials that fit your budget, brewing space, and needs as a brewer.

Happy brewing!



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Edited by Blair Dils and Leslie Noyes

Cover illustration by Mary Rich

Cover design by Carol J. Jessop (Black Trout Design)

Text illustrations by Randy Mosher

Text design and production by Leslie Noyes

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Printed in the United States by Excelsior

Library of Congress Cataloging-in-Publication Data

Lutzen, Karl F., 1961-

Building homebrew equipment / excerpted from Brew ware by Karl F. Lutzen & Mark Stevens.

p. cm

ISBN 978-1-58017-138-0 (alk. paper)

1. Brewing—Amateurs' manuals. I. Stevens, Mark, 1960- II. Title
TP570.L882 1998
641.8'73—dc21

98-37259

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